said blade, or replacing it by another, and then replacing the blade-holder.

In Figs. 9 and 10 I have shown a somewhat modified construction of my apparatus, according to which the alternate abrading-wheels 6′ rotate in opposite directions and are not reversed at all, one of each pair of said wheels being driven, as previously described, by means of a gear 9′, meshing with the central gear 10, and the other abrading-wheel of each pair being driven by supplying its spindle with a gear 9″, meshing with the gear 9′, which drives the adjacent spindle. In this case the spindles which carry the gears 9″ are journaled at a somewhat greater distance from the center of the table 2′ than their companion spindles, as shown in Fig. 10, in order that said gears 9″ may not mesh with the central gear 10, and the channel 32′ in the ring 31′ is made wide enough to receive the lower ends of all of said spindles. The central gear 10 is secured to the vertical shaft 11, constructed and supported as previously described; but the gear 44′, which drives said shaft, is secured to a driving-shaft 39′, which is distinct from the shaft 39 and may be journaled thereon, said shaft 39′ being provided with a fixed driving-pulley 40′, which is continuously rotated in the same direction. With this arrangement of abrading-wheels the blade-carriers are located alternately inside and outside of the circle of abrading-wheels, and the inner series of blade-carriers is driven, as previously described, by means of the central gear 18, meshing with the gears 17′, secured to the respective spindles on which the blade-carrying caps 12′ are mounted, the reversal of these spindles and the resulting oscillation of the blades being accomplished by the same arrangement of shafts, belts, and reversing mechanism as that previously described. For convenience the blade-carriers located outside of the circle of abrading-wheels are oscillated by means of yielding connections between them and the inner series of blade-carriers, so that the blades carried by both the inner and outer carriers will be held against the respective abrading-wheels with a pressure which cannot exceed that produced by the rotation of the respective spindles which actuate the inner carriers. As preferably constructed each outer carrier consists of a cap 12″, journaled on a fixed vertical spindle 13″ and provided with a laterally-extending tube 20″ for receiving a blade-holder. Said cap 12″ is connected with the corresponding cap 12′ by means of a rod 100, passing loosely through the perforated ends of arms 101 and 102, rigidly secured to said caps 12′ and 12″, respectively, the connection between these arms being made yielding by means of springs 103, bearing against said arms 101 and 102 and against nuts 104, secured to said rod 100. These parts should be so proportioned that the blade carried by each cap 12″ will be brought into contact with a wheel 6′ a little before the blade carried by the corresponding cap 12′ is brought into contact with its wheel 6′, so that the last portion of the movement of the latter cap will compress one of the springs 103, and thus provide a force for holding the former blade against the abrading-surface. This force will evidently diminish by its own amount the pressure with which the blade carried by the cap 12′ would otherwise press against its wheel 6′ and may be compensated by suitably weighting said cap 12′, and thus increasing the friction between it and the friction-disk which supports it. As thus constructed all the abrading-wheels will rotate in the same direction with respect to the edges of the respective blades which are applied thereto, and each blade will be periodically oscillated between two adjacent wheels and held against the same with a yielding pressure, which is regulated by the amount of friction between its cap 12′ and the spindle which supports and actuates it. It will be evident that the outer series of blade-carriers may be omitted, if desired, with no other result than the reducing of the capacity of the machine one-half.

In Fig. 11 I have shown a construction by means of which my machine may be adapted to grind twice as many blades at one time as with the constructions above described. According to this modification I provide each spindle 7^a with two abrading-wheels 6^a, located one above the other, and each spindle 13^a carries two blade-carrying caps 12^a, correspondingly located one above the other and independently supported on friction-disks 14^a, resting upon collars 15^a, rigidly secured to said spindle, each of said caps being provided with a laterally-extending tube 20^a, as previously described. With this construction each spindle 13^a will hold each of the blades which it carries against the corresponding abrading-wheel with a pressure which is wholly independent of the pressure applied to the other blade, and both of said blades will be simultaneously oscillated, as will be evident. It will also be evident that more than two abrading-wheels and blade-carriers might be superimposed in this manner, if desired, and that a series of wheels and carriers so constructed may be arranged and operated as shown in Figs. 10 and 11, as well as in the manner shown in other figures of the drawings, and I do not consider my invention to be limited to any specific number or arrangement of abrading-wheels or to any particular mechanism for rotating them, since the apparatus herein shown and described may be greatly varied in these particulars and in its other features of construction without departing from my invention.

I claim as my invention—

1. In a machine of the character described,